



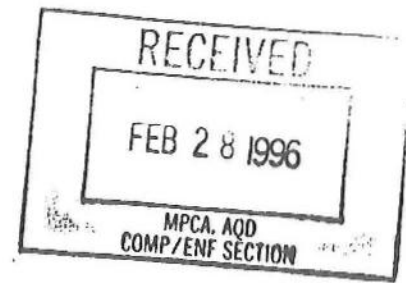
Metropolitan Council

Working for the Region, Planning for the Future

Environmental Services

February 23, 1996

Mr. Hans Walter-Peterson
Minnesota Pollution Control Agency
Air Quality Division
Compliance and Enforcement Section
520 Lafayette Road
St. Paul, MN 55155



Subject: Metropolitan Wastewater Treatment Plant
Operating Permit 879-90-OT-3
Summary of Emergency Damper Leakage

Dear Mr. Walter-Peterson:

As indicated in the telephone report of January 31, as well as during your February 9 inspection, Metro Plant staff were preparing a complete report evaluating the problems occurring with the damper leakage at the Metro Plant. The report describing the findings and response is attached.

Should you have any questions regarding the report, please contact Jim Brown at the Metro Plant at 772-7222, or Melba Hensel of my staff at 229-2072.

Sincerely,

Keith J. Buttleman, Director
Environmental Planning and Evaluation Department

KJB:MH:mmh

Attachment

cc: Bill Moore
Jim Corcoran
Jim Brown (Metro/Region 3)
Joanne Hart

SUMMARY OF
EMERGENCY DAMPER LEAKAGE

from

METRO PLANT INCINERATORS

September 1995 through February 1996

Metro Plant
Process Control Group
February 1996

BACKGROUND

The Metro Plant multiple hearth incinerators use an Induced Draft (ID) fan to pull hot flue gas through the air pollution control train. Under certain circumstances, the ID fan can lose the ability to move the flue gas. Reasons range from a loss of ID fan electrical power to the mechanical failure of a component in the pollution control train.

When the ID fan is unable to withdraw the hot flue gas, that gas must be vented through the emergency damper to the emergency stack, where a natural draft discharges it to the atmosphere. This is an essential safety feature for an incinerator. Without the emergency damper/stack arrangement, failure of the ID system would cause hot flue gas to vent directly into the incinerator building. Severe damage to equipment and injury to personnel would result. The emergency stack arrangement is shown in Figure 1.

Flue gas is routed to the emergency stack through the emergency breaching. This consists of a section of refractory-lined ductwork, eight feet wide with a height ranging from 54 to 66 inches. The length of this duct ranges from 15 to 20 feet. The emergency damper is located in this section of duct. Under normal operation, with flue gas withdrawn by the ID fan, the emergency damper is closed. When the ID system becomes unavailable, the emergency damper automatically opens to vent gas to the emergency stack. When this occurs, the sludge feed to the incinerator is halted by electronic interlocks.

The emergency damper is a large 4" thick slab of castable refractory material in a rectangular metal frame. It slides up and down in 9" wide metal guides across the duct to control air flow. The bottom of the damper rests upon a 10" high refractory ledge across the duct. Gaskets, consisting of 6" wide strips of ceramic fiber refractory material are located on both upstream and downstream sides of the duct at the damper location. The gaskets are intended to prevent leakage around the sides of the damper where it runs up and down in the guides. They also prevent leakage at the top of the duct where the damper housing is connected. The gaskets are attached to the sides and top of the refractory duct with an anchoring system. Figures 2 and 3 show the emergency damper configuration. Note that the "Ceramic Fiber Seat" shown in Figure 3 is a modification newly installed on Inc. 7 in early February. It will be fully discussed in a later section. During all periods of leakage that will be covered in this report, the bottom seat consisted of the metal damper frame in contact with the refractory seating ledge.

Ash hoppers are located directly in front of the emergency dampers, on the incinerator side. The high degree of turbulence on Hearth Zero causes a small amount of ash to swirl back into the dead air space in front of the damper, where the ash settles out. The hoppers are equipped with ash removal piping which is serviced by the incinerator ash

removal system on a scheduled frequency. Failure to prevent a pile-up of ash in front of the emergency damper could hamper damper operation by allowing ash to spill over onto the seating ledge when the damper opens. When the damper closes, the effectiveness of the seal could be compromised.

There are a total of 4 emergency stacks for the 6 incinerators. Incinerators 5 and 7 share a common stack, as do 6 and 8. Incinerators 9 and 10 have separate stacks. The stacks for 9 and 10 have one feature that the other two do not. For Inc. 9 and 10, the hot shaft cooling air, with a temperature over 200°F, is routed into the emergency stacks one floor above the connection from the emergency duct. This creates higher background temperatures in those two stacks. It's important to note that the shaft cooling air is clean building air forced through the center shaft under pressure so that it is not contaminated with flue gas.

Summary of Leakage Events

The initial documented case of leakage past an emergency damper and up the emergency stack occurred from Incinerator 5 in September of 1995. Incinerator 5 had started taking feed on Wednesday, August 30 after having been held in a warm standby mode for belt conveyor repairs. On Friday, September 1, the Inc. 5/7 emergency stack was visually observed to be smoking lightly in spite of the fact that both Incinerators 5 and 7 were running in the ID mode with emergency dampers in the fully-closed position. Since there had been no change to the status of Inc. 7, it was assumed that Inc. 5 was the source of the leakage, and feed was immediately halted and sludge in the furnace was burned-out.

It was thought that ash might be preventing the emergency damper from closing fully. An attempt was therefore made to clear any ash from the damper seat area. When feed was subsequently restarted, the stack was still leaking.

The Met Council's Air Quality Department was contacted to try to measure airflow in the emergency stack. Their efforts at measuring flow on September 5 were inconclusive due to the small amount of airflow in the stack. Air Quality then attempted to make a qualitative judgement of the degree of leakage. They read visible emissions for six minutes at 15-second intervals. All opacity readings were zero.

Although Air Quality had been unable to measure any leakage, a thorough inspection of the emergency damper was conducted. The incinerator had to cool down for three days before the work could be done. When the damper was inspected, no physical problems were found with the seat or the damper itself. Some ash was removed from in front of the damper.

After the inspection, Inc. 5 was put back in service on September 11. Air Quality returned on September 12 to recheck the emergency stack, but again they could draw no firm conclusion. Visual inspections conducted over the next several days did not detect any further leakage.

For purpose of PM-10 reporting for the 1995 State Implementation Plan (SIP), Inc. 5 was assumed to be leaking from August 30 (when it first came on-line) until September 5, when the feed was discontinued in preparation for the internal inspection. The emission rate during this period is impossible to quantify, but all observers agreed it was quite minimal. The leakage was conservatively estimated to amount to 10% of the site-specific, calculated, uncontrolled PM-10 emission rate of 2.2 lb/minute. The resultant 0.22 lb/minute is almost 65% of the AP-42 Uncontrolled Emission Factor for PM-10 from incinerators, thus emphasizing that the estimate of emissions was conservative in the extreme.

On-going visual inspections of the emergency stacks showed no leakage until October 10, at which time emission from the common stack for 5 and 7 were again detected. Both furnaces were removed from service and the dampers were inspected and ash cleaned from the seats. Feed was then resumed to evaluate the results.

The visual observation that leakage was occurring was verified by Air Quality on October 12. They extracted gas samples from the emergency stack and measured CO, CO₂, and NO_x. Results definitely confirmed the presence of flue gas.

After further damper inspections identified the leakage source as Inc. 5, further unsuccessful attempts to seat that damper ensued. Finally, on October 16, the leakage was eliminated by using, for the first time, a high Hearth O draft to reverse the direction of flow past the leaking damper. Air from the stack is drawn into the incinerator by the increased pull of the ID fan.

Use of a high draft to control leakage is recognized as a treatment of symptoms rather than a cure. There are several distinct drawbacks. Fuel use on Hearth O to maintain the 1200°F exit temperature increases due to the introduction of cool air past the emergency damper. The same air, with its 21% oxygen content increases the wet oxygen concentration and can cause permit excursions. Finally, there are ID fan capacity impacts related to pulling additional air through the flue gas system.

In spite of these drawbacks, a draft of -0.5" to -0.6" WC was maintained after October 16. Visual observations confirmed that leakage had been eliminated. Additional PM-10 amounts were included in the 1995 SIP report for the period of October 10 to October 16.

After this second episode, it became obvious that a better method of detecting leakage than visual observation was needed. On October 17, a work order was generated for Metro Maintenance to install thermocouples with temperature transmitters connected to

the plant computer system on each emergency stack. Monitoring of stack temperatures provides a positive indication of the presence of leakage. Figure 4 shows the monitoring configuration that was ultimately installed.

The 5/7 stack was done first, with the thermocouple becoming active on October 23. Draft was still being held high to prevent leakage. Temperature in the stack was only 48°F, verifying no leakage. The draft was successfully reduced to -0.3", only a bit higher than normal, without having the stack temperature rise.

Inc. 5 draft was maintained at -0.3" from October 26 through November 8. On November 12, the stack temperature again indicated leakage. It was found that the Inc. 5 draft had been mistakenly reduced to normal on November 8 and that leakage had resumed. The draft was immediately reset to -0.3" and the leakage was stopped, as verified by the stack temperature. Additional PM-10 amounts were included in the 1995 SIP for November 8 through 11.

The Inc. 5 draft was held at -0.3" until December 18. No leakage occurred, but the air being drawn into Hearth 0 was causing wet oxygen excursions. The draft was reset to normal to see whether leakage would resume. It did not. It can only be assumed that sometime during the high draft period after November 11 the damper had made a good seal after one of its occasional operations. Continuous monitoring of the 5/7 stack temperature verified that there was no leakage at normal draft.

Earlier in December, discussions began with Metro Maintenance to consider modifications to the emergency damper sealing arrangement to prevent leakage. The work ultimately agreed-upon is described in the next section of this report, Damper Modifications. Incinerator 7, which was down for its annual maintenance in December, was selected as the unit to be first modified.

The thermocouple for the Inc. 6/8 emergency stack went into service in early November. The first instance of leakage detected in that stack occurred January of 1996. The Inc. 8 emergency damper opened briefly, then closed again at 2 p.m. on January 17. It failed to seal tightly upon closing. The Maintenance department inspected the damper twice with no success in stopping the leakage. On Friday, January 19 the draft was increased for the upcoming weekend to halt the leakage. The stack temperature verified that this measure was effective. On Monday, January 22, the damper seat was cleaned with an air lance and the furnace returned to service at normal draft. No further leakage occurred, as demonstrated by very low stack temperatures, until the end of January, when another brief episode of leakage occurred. Additional PM-10 emissions will be included in the 1996 SIP for January 17 through 19 and for portions of January 31.

Incinerator 9 also experienced leakage late in January, beginning on January 29. Ash was removed from both sides of the emergency damper on that same day and the seat area was cleared off with the air lance. The process was repeated the next day, and a high draft was utilized to halt the leakage. After several days at the high value, the draft was returned to normal and it was discovered that the leakage had ceased. To date, the Inc. 9 stack remains leakage-free at normal draft. Additional PM-10 amounts will be added to the 1996 SIP for portions of January 29 through 31.

The final leakage situation involves Inc. 10. Leakage was observed from the emergency stack on January 26 and was verified by stack temperature data. Figure 5 illustrates this situation. Ash was removed from both sides of the damper on the same day. Portions of the sealing gasket on the downstream side of the emergency damper were seen to be missing. The seat area was cleaned with the air lance. The same actions were repeated on January 29 and January 31 since the stack was still leaking after January 26. A high draft was used, but even so leakage continued into the first part of February. The draft setpoint had to be raised to values as high as -0.5" to control the leakage.

PM-10 amounts will be added to the 1996 SIP for the last week of January and on into February.

Damper Modifications

The numerous inspections and ash removals conducted during the past few months led to the conclusion that two areas are critical in preventing leakage around the emergency damper. These areas are the gaskets sealing the side and top of the damper, and the bottom seat.

In all the cases of leakage, portions of gasket were found to be either damaged or missing. This can obviously contribute to leakage. It appears that, over the course of repeated damper movements, the anchors are unable to prevent the gasket material from being pulled away from the duct.

Metro Maintenance has attempted to address this problem with a new patented anchoring system. Inc. 7, which was down for its annual maintenance in January of 1996 and began burning sludge on February 8, was available to function as the test unit. The new anchoring system was used to fasten the gasket to the interior surface of the duct on both sides of the emergency damper.

The seat area, where the metal damper frame meets the hard refractory ledge, is the other focus of concern. There definitely appears to be potential for a bad seal in this area that can allow leakage. The failure to achieve a tight seal is certainly, but perhaps not exclusively, related to ash. The leakage of Inc. 8 during January 1996, for instance, was halted by blowing ash away from the seat area. In the on-going case of Inc. 10, however, the same measures have not proven effective. In any event, the seat is an area that requires attention.

Two different modifications are being implemented for the seat area. The first item is the addition of a hatch thru the duct wall to provide access to the seat area. The height of the hatch is set so that it is adjacent to the top of the seating ledge. The intent is to provide easier access for cleaning ash off the ledge. This task has thus far been done by opening the duct access door between the emergency stack and damper and extending an air lance to the seat. Inc. 5 will be the first unit with this feature.

The more important seat modification is the addition of a layer of ceramic fiber refractory material to the bottom of the metal damper frame, as shown in Figure 3. This material extends across the entire width of the damper, has a height of 6 inches and a thickness of 4 inches. The intent is to provide a compressible layer between the hard surfaces of the damper frame and refractory ledge. It will allow a good seal to be maintained if some ash lies on the ledge as the damper descends, or if the damper closes in an imperfectly level position.

Current Status (Monday, February 12) and Future Plans

Five incinerators, covering all four emergency stacks, are in service. Temperatures in the emergency stacks show that no leakage is occurring. In the case of Incinerator 10, however, the draft must be held at a high value (-0.4" to -0.5" WC) to prevent leakage. Figure 6 illustrates a typical case of no leakage under normal draft conditions. Figure 7 shows a high draft on Inc. 10 being used to prevent leakage.

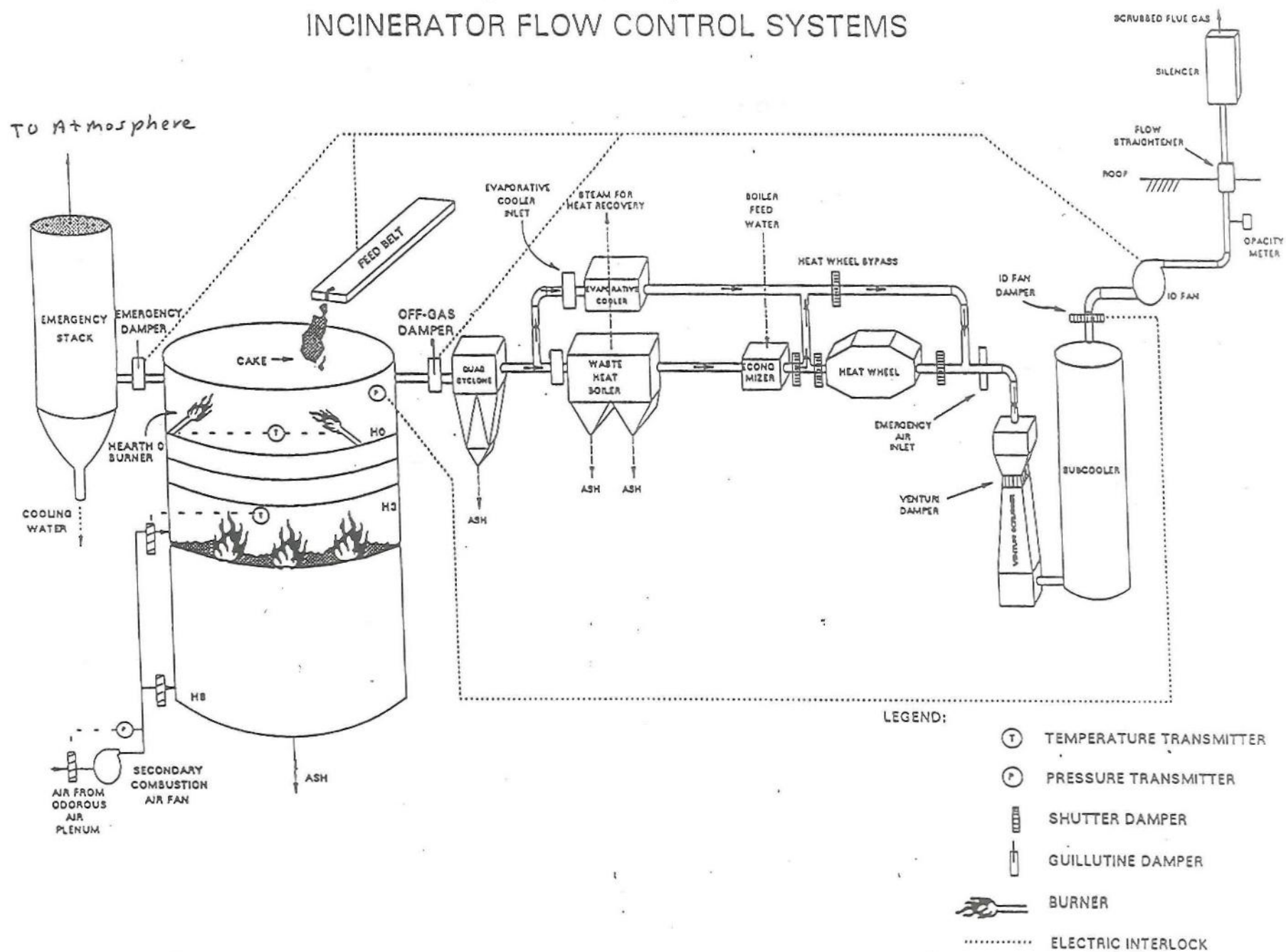
There's been no leakage from Incinerator 7 in the short time that the damper modifications have been in place. Up to this point, the modifications have not yet been subjected to severe conditions resulting from multiple operation of the emergency damper. Our intention is to run an accelerated stress test on the modification within the next few weeks. The incinerator feed will be stopped, and after burning out the incinerator, we'll run the emergency damper up and down several times. A visual inspection of the seat and gasket condition will be conducted and the incinerator will then be returned to service.

If the damper modifications appear even partially effective, they'll be added to the other five incinerators at the earliest opportunity. Incinerator 5 is currently down for annual maintenance, due back in service at the beginning of March. The damper work could be done on Inc. 5 before it returns to service. For the remaining furnaces, the work would be included in the 1996 annual maintenance periods or sooner if scheduling opportunities occur.

In the meantime, temperatures of the emergency stacks will continue to be monitored on an on-going basis. If elevated temperatures occur, the damper seats will be inspected and cleaned. If necessary, the incinerator drafts will be increased to prevent leakage. Any resultant additions of PM-10 emissions for SIP reporting will be documented and applied.

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FIGURE 1
INCINERATOR FLOW CONTROL SYSTEMS



SIDE VIEW OF EMERGENCY BREACH/DAMPER - FIGURE 2

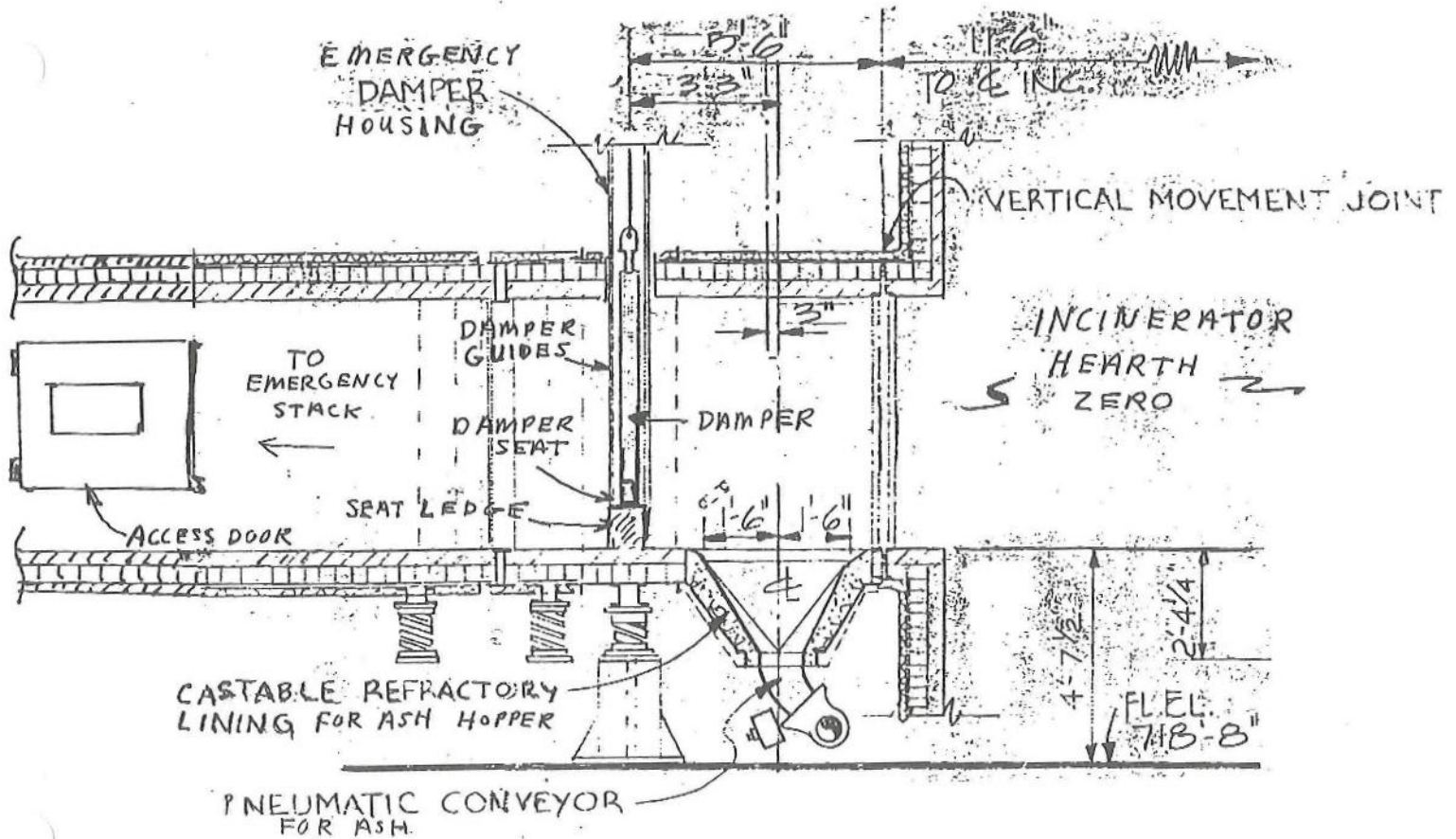


FIGURE 3
VIEW OF EMERGENCY BREACH/DAMPER FROM INSIDE HEARTH

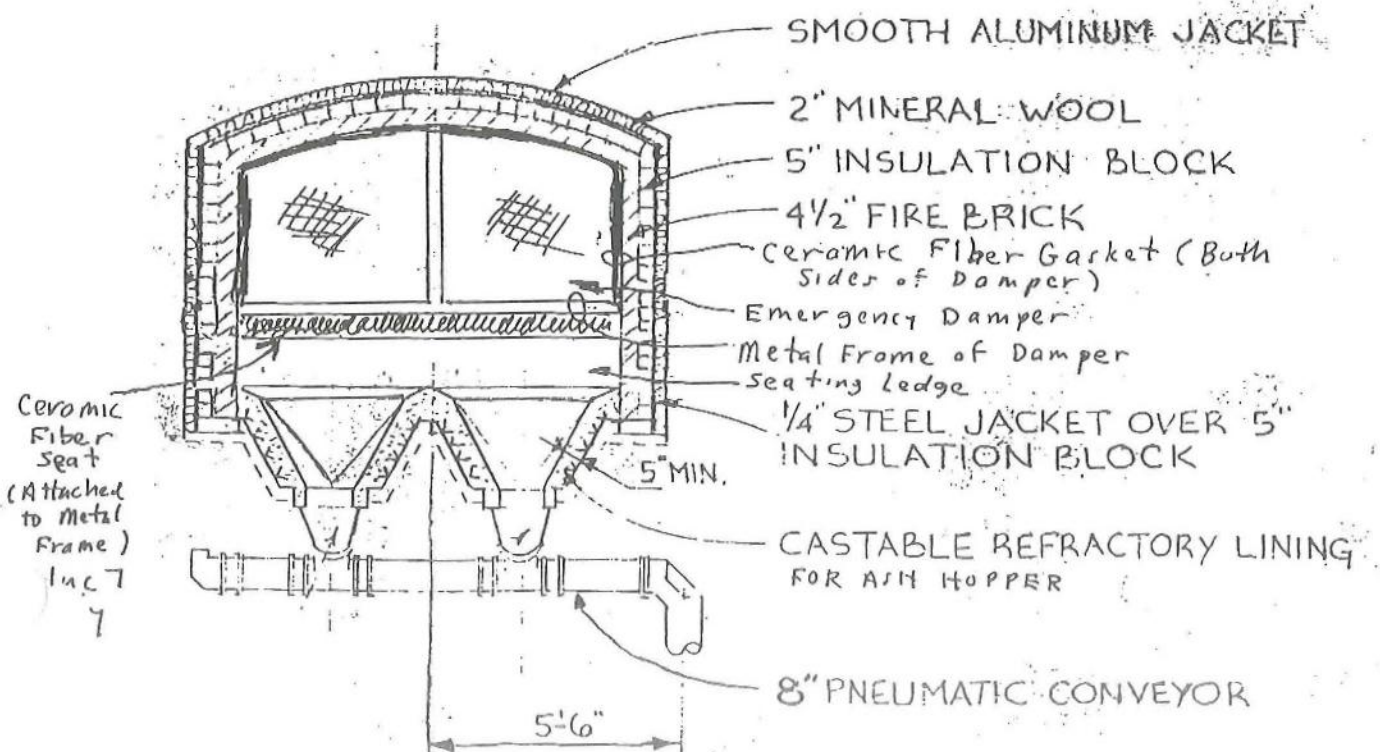
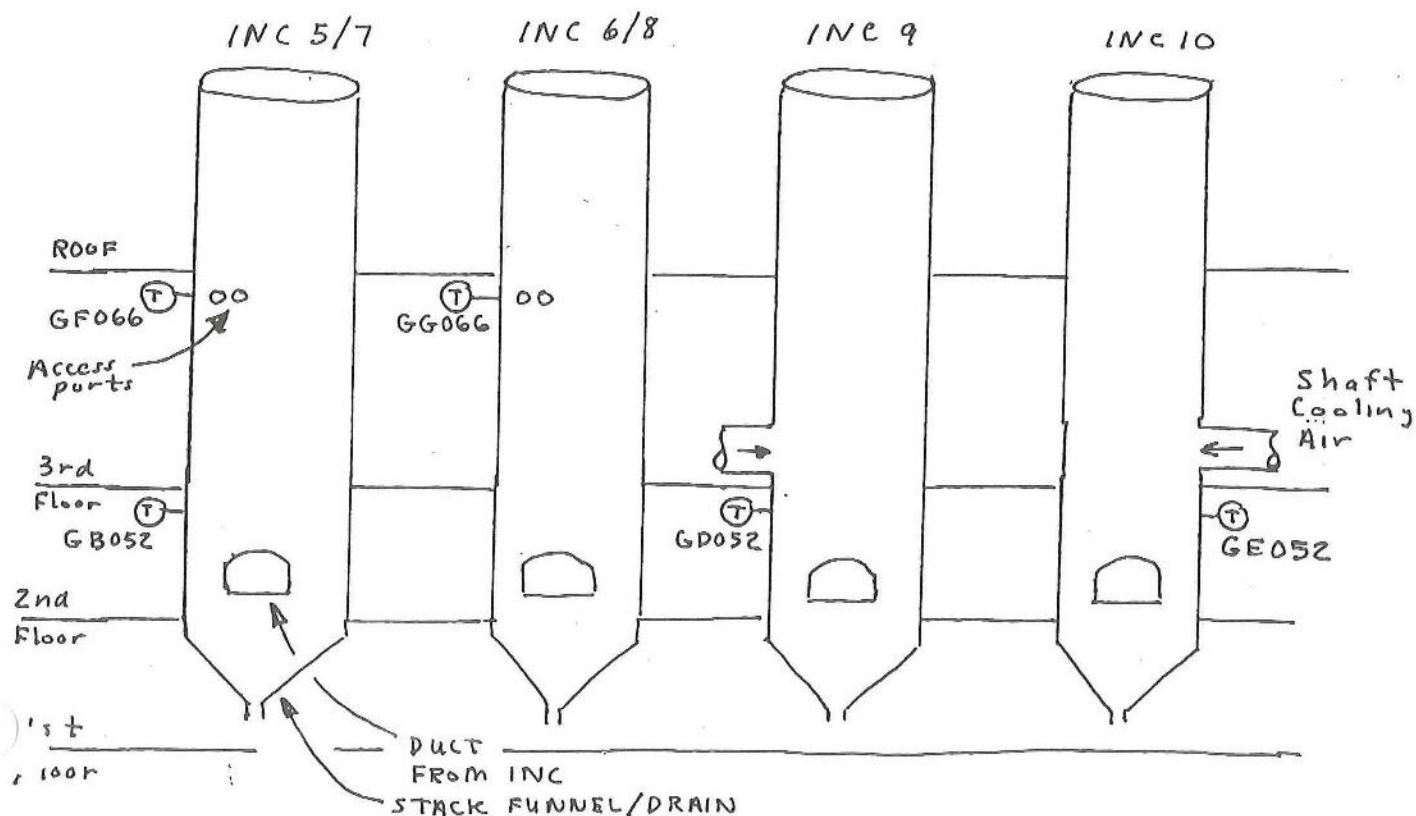


FIGURE 4

THERMOCOUPLES FOR MONITORING
OF EMERGENCY STACK TEMPERATURES



GB 052 T T - 5/7 Stack, top of 2nd floor
 GF 066 T T - 5/7 Stack, below roof line
 GG 066 T T - 6/8 Stack, below roof line
 GD 052 T T - Inc, 9 Stack, top of 2nd floor
 GE 052 T T - Inc 10 Stack, top of 2nd floor

Figure 5

Inc 10 - Leakage Up Emergency Stack at Moderate Draft

Inc 10 draft running from -0.11 to -0.42 ", with a mean value of -0.29 ". These values are higher than normal, but not as high as the -0.4 to -0.5 " needed to halt leakage. Stack temp ranges from 262 to 438 °F, indicating leakage past the emergency damper

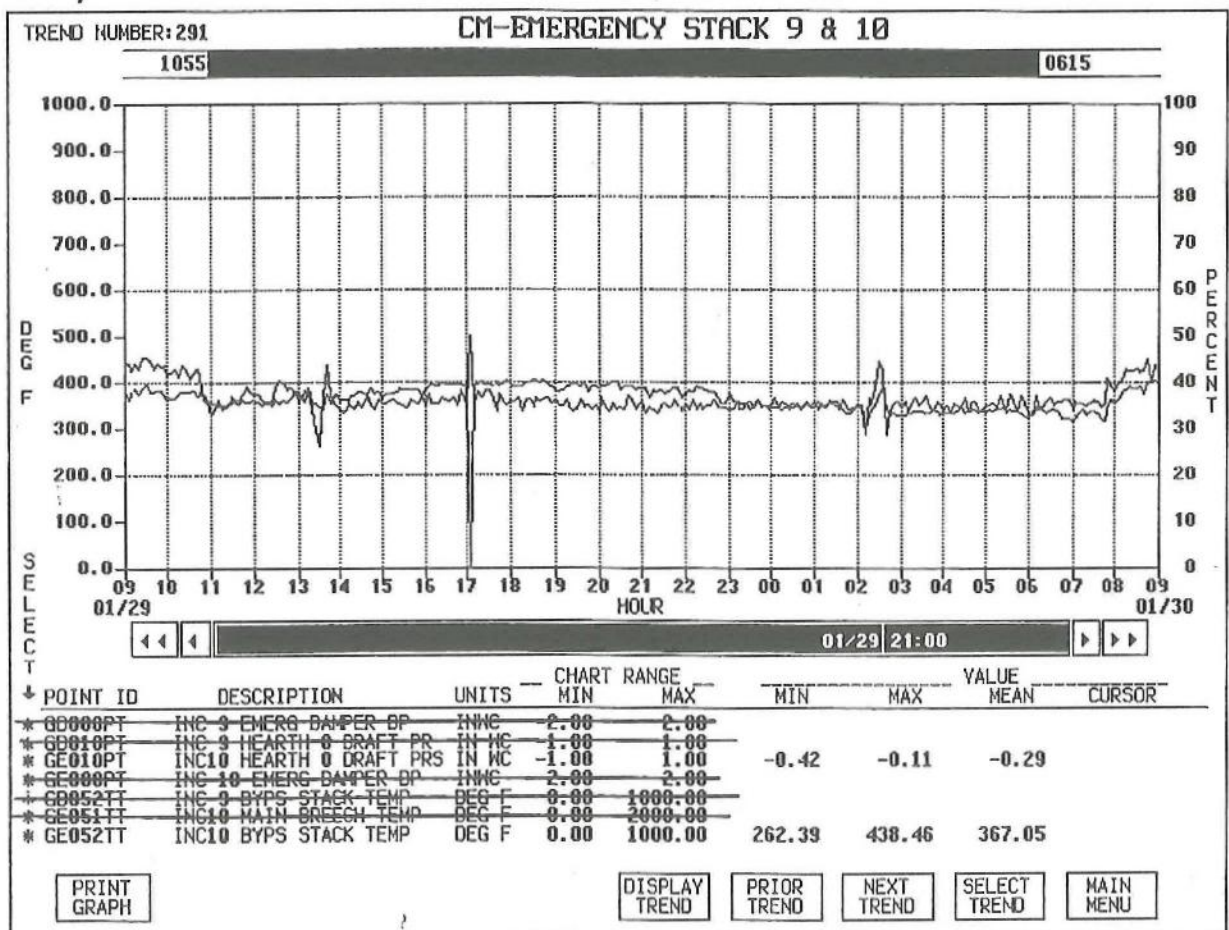


FIGURE 6

No leakage at normal draft Inc # 9.

With the draft ranging from $-0.1''$ to $-0.24''$ WC, the stack temp is between 145°F and 165°F . No leakage is occurring. The stack temp does not drop down to outdoor levels because of the introduction of hot shaft cooling air (200°F) into the emergency stack right above the thermocouple. (This arrangement applies to Inc 9 and 10 only.)

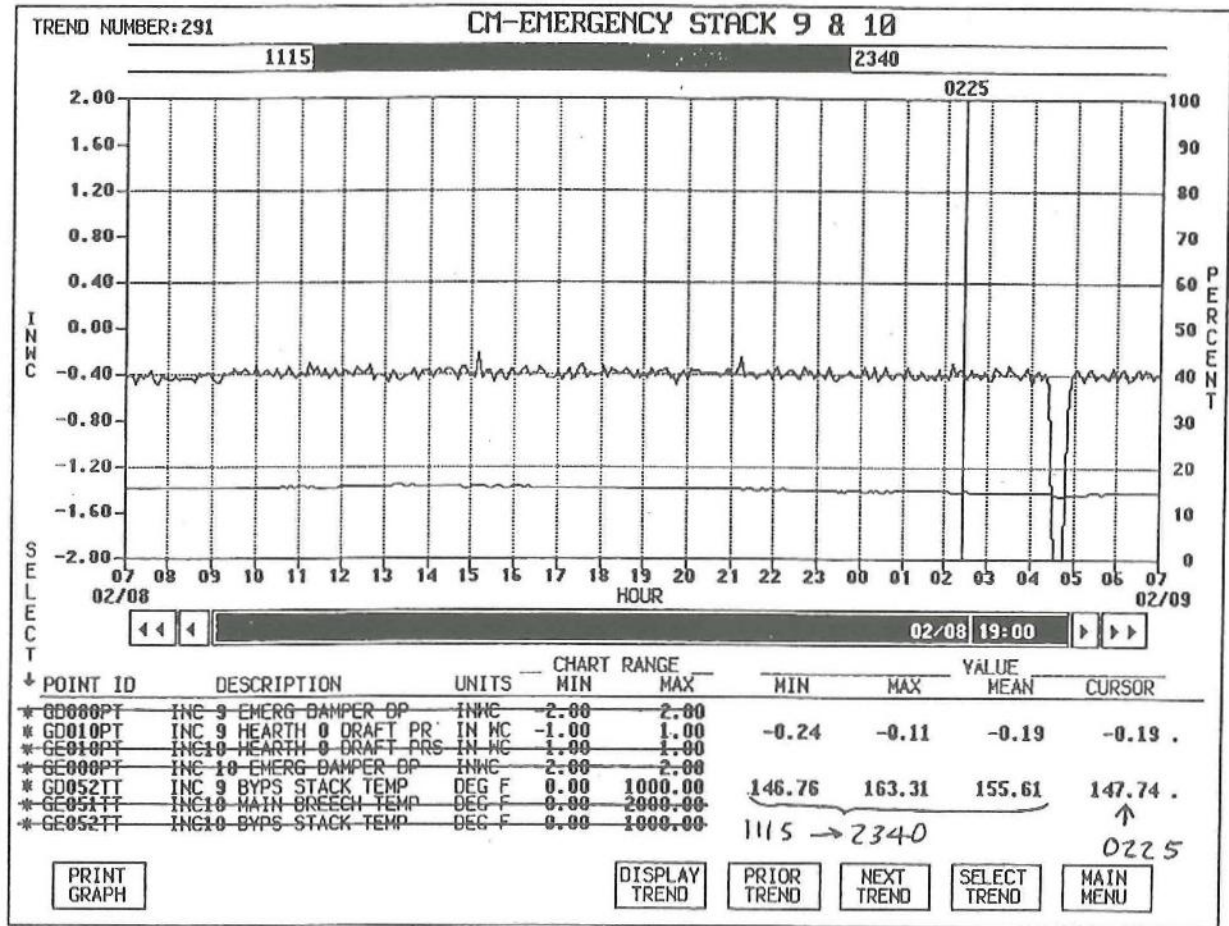


FIGURE 7

Leakage on Inc 10 Prevented by High Draft.

At 1400 the draft was returned to normal to see whether leaking would resume. It did, as indicated by the stack temp increase to 252°F. Draft again increased at 1530, and stack temp dropped below 200°F, showing that leakage was back under control.

